A METHOD AND AN ARRANGEMENT FOR SUPPORTING VERTICALLY DEPENDING ELECTRICAL RESISTANCE ELEMENTS

The present invention relates to a method and an arrangement for supporting vertically depending electrical resistance elements.

Such resistance elements are used primarily to heat industrial furnaces or ovens. Each element comprises current conducting legs that run downwards and upwards a number of times. The top of the element merges with a number of terminals that are connected to one more sources of electric current. The element thus hangs from the roof of the furnace and extends downwards in operation. The legs are subjected to strong thermal variations in operation, due to the power developed therein. This variation results in bending or twisting of individual legs in the element as the temperature changes. Consequently, the element is provided along its length with a number of ceramic discs that include through-penetrating holes through which respective element legs extend. These ceramic discs are intended to hold the legs of the element apart and therewith out of contact with one another. Mutual contact of the legs would cause the element to short circuit, resulting in serious damage, if not destruction, of the resistance element.

The uppermost ceramic disc or the uppermost discs may also serve to support the weight of the resistance element. According to the present standpoint of techniques this is achieved by coupling pairs of legs together with the aid of current conducting plates which rest on the uppermost ceramic disc or on the uppermost discs, depending on the geometry of the resistance element concerned. Legs thus extend pair-wise through a ceramic suspension disc and are joined together on the upper side of said disc through the medium of such a current conducting plate and supported in this way by the ceramic disc.

The power developed in the legs is often very high. Typical powers developed in the legs of a resistance element in industrial operation can be in the order of 20–50 kW. The resistance element is often driven cyclically, meaning that the temperature in the vicinity of the ceramic plates will vary over a wide temperature range in the space of time.

This heavy thermal load in combination with the mechanical load borne by the supportive ceramic discs results in the formation of cracks in said discs and finally in fracturing of the

discs. When this occurs, the resistance element will no longer be supported by the broken discs and will collapse down into the furnace, therewith resulting in significant repair costs.

A typical life span of a supporting ceramic disc is in the order of three to six months.

An industrial furnace may include a considerable number of resistance elements, for example several hundred. This means that serious costs are often incurred in changing or replacing supportive ceramic discs. It is therefore desirable to find a way of increasing the useful length of life of such discs.

Accordingly, the present invention relates to a method and to an arrangement for supporting vertically hanging electrical resistance elements for heating furnaces or ovens in industrial operation, wherein each element comprises current conducting legs that run downwards and upwards a number of times, wherein the resistance element includes along its length a number of ceramic discs that are provided with holes through which respective element legs extend, wherein the upper part of said element merges with terminals that are connected to a source of electric current, wherein said element is supported by at least one of the uppermost of said ceramic discs, and is characterised in that the uppermost ceramic disc or the uppermost ceramic discs by which the element is supported is/are placed in the roof insulation of the furnace above the underside of said roof; and in that legs of the element are caused to be short circuited at a location slightly or somewhat beneath the underside of said roof with the aid of short circuiting plates.

The invention also relates to an arrangement of the kind and with the general features set forth in the accompanying Claim 6.

The invention will now be described in more detail with reference to a non-limiting exemplifying embodiment thereof and also with reference to Figure 1.

Figure 1 illustrates a resistance element 1 according to the present invention, mounted in a furnace 2. The resistance element 1 extends through the roof insulation 3 of the furnace 2 and down into the heated furnace volume 4. The temperature in the heated volume 4 is extremely high and sometimes varies cyclically in the operation of the furnace. The

temperature diminishes gradually upwards in the insulation 3 as seen in the Figure, down to essentially room temperature above the upper edge of the insulation 3.

The resistance element 1 is driven through the agency of two terminals 5 connected to an external source of electric current. The resistance element 1 includes along its length a number of legs 6 which extend down into the heated volume 4 of the furnace and up again to the insulation 3 of the furnace 2. The legs 6 are coupled together in pairs with the aid of a number of short circuiting plates 7, which are preferably made of the same material as the legs themselves. These short circuiting plates 7 are situated below the lower surface 15 of the furnace roof.

One of the legs 6 is also coupled to the input terminal 5a and another of the legs 6 is coupled to the output terminal 5b. This allows current to flow in through the input terminal 5a, through all legs 6 and finally out through the output terminal 5b.

The number of terminals 5 may be varied for different purposes, for instance to enable furnace power to be controlled. The terminals 5 may also be connected to several external sources of electric current.

The legs 6 are preferably comprised of FeCrAl.

In order to prevent short circuiting between the legs 6 when the temperature varies, a number of disc-shaped ceramic spacers 8 are dispersed longitudinally along the length of the resistance element 1, said ceramic spacers 8 being held in place by a central rod 9 extending through the resistance element 1.

The ceramic spacers 8 are preferably configured from Al_2O_3, SiO_2 or a mixture thereof, these materials being electrically insulating.

The two uppermost ceramic discs 10, 11 are placed above the upper inner surface of the heated volume 4 of the furnace 2, within the insulation 3 of the furnace roof 2. These uppermost ceramic discs 10. 11 serve to support the weight of the element 1, in addition to functioning as spacer means between the legs 6. This weight supporting function is achieved by virtue of the legs 6 being coupled pair-wise with the aid of a number of short

circuiting plates 12, 13, 14, which rest on the upper surface of both of said uppermost ceramic disks 10, 11.

Thus, as a result of the short circuiting plates 7 present in the furnace space, much less current will flow through that part of the legs 6 situated in the furnace insulation 3 than that which flows through those parts of the legs 6 situated in the heated volume 4 of the furnace 2.

Solely the current that flows from the input terminal and through a leg down through the insulation 3 of the furnace 2 and the current that flows through a leg through the insulation 3 of the furnace 2 and out through the output terminal contributes to the thermal development of power in the legs in the region of the insulation 3 of the furnace 2.

Because the ceramic plates 12 are comprised of an electrically insulating material, the power developed by the current passing through the legs and through the ceramic plates 12, in other words the current flowing through the legs above the upper surface of the heated volume 4 of the furnace 2, will be negligible.

The thermal load on the supportive ceramic discs 8 is greatly reduced by virtue of the temperature in the insulation 3 of the furnace 2 being much lower than the temperature of the heated volume 4 of the furnace 2. The non-supporting ceramic discs remain under thermal loading. Thus, the present invention circumvents the problem relating to the application of both thermal and mechanical loads to supportive ceramic discs.

The thermal load on the supportive ceramic discs 8 can be reduced still further, by placing said discs above the upper surface of the insulation 3 of the furnace 2, in other words externally of the furnace and therewith under essentially room temperature conditions.

In this way, the present invention increases the life span of the supportive ceramic discs from the normal three to six months applicable in the case of the present standpoint of techniques to from two to four years, thereby greatly reducing the running costs of this type of resistance element in industrial applications.

Moreover, because the thermal load on the supportive discs is reduced significantly, the discs can be given smaller dimensions according to the present invention than has been possible hitherto. In turn, this enables resistance elements to be given geometries that are novel or expanded with respect to geometries applicable to the present standpoint of techniques. Alternatively, larger resistance elements can be constructed with the aid of the present invention due to the fact that the supportive discs are now able to withstand a greater load as a result of the substantial reduction in the thermal load on the discs.

Furthermore, the inventive electrical resistance element can be run with a higher power than was possible with resistance elements according to the present standpoint of techniques, for the same reasons as those mentioned above.

Although the invention has been described above with reference to a number of embodiments thereof, it will be understood that hese embodiments can be varied with respect to the type of element concerned for instance.

The present invention shall not therefore be considered to be restricted to the embodiments indicated above since variations can be made within the scope of the accompanying claims.